

RotCFD: A Viscous Design Tool for Advanced Configurations

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Technical Abstract

During initial design studies, parametric variation of vehicle geometry is routine. In addition, rotorcraft engineers traditionally use the wind tunnel to evaluate and finalize designs. Correlation between wind tunnel results and flight tests, when not good, have been often attributed in part to uncertainty in blockage corrections. Estimation of rotor blockage is significantly more complex than bluff body corrections as the correction depends on operational characteristics such as rotor RPM and thrust produced. This proposal offers to develop an Integrated Design Environment (IDE) which can simulate a complete rotorcraft with or without wind tunnel walls including all the facility effects. At the heart of the innovation are: 1. An automated hybrid grid generator. (viscous grids near the bodies and unstructured Cartesian grid everywhere else) 2. A robust and economical incompressible flow solver for the entire system of grids. 3. Momentum source based rotor model that is suitable and economical for simulating configurations with multiple rotors. In Phase I, the proof-of-concept developed used unstructured Cartesian grid for the model and wind tunnel. In phase II, the tool will be extended to hybrid grid with viscous grid near solid surfaces and will include several tools including a simple CAD like geometry manipulation tool and pre- and post-processing tools all integrated in one environment to facilitate ease of use.

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